Strategies, programs, and projects pertaining to policy on transport: research in selected European states, the United States, and Japan (short title: 'SmartBench') ; final report on Sweden

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Final Report on Sweden

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Abstract

The government in Sweden champions the international competitiveness of the country's economy and industry. The structure and substance of transport research in Sweden is in constant flux. Because Sweden has its own automotive industry, extensive and cost-intensive research programs on vehicle development are conducted in cooperation with industry, the research community, and the government and are largely financed by the Swedish state.

Setting priorities in transport research also seems to come easier to Sweden than to Germany, where authority is shared by the federal government, state governments, and their respective ministries in a way unknown in Sweden. On the whole, Sweden is one of the world's innovative leaders in both applied and basic research on transport, an assessment reflected in the ambitious objectives of the country's transport policy. An outstanding example thereof is "Vision Zero," Sweden's long-term goal of completely eliminating deaths due to accidents.

Sweden, like other countries, is grappling with the impacts of mass motorization. In comparison to the German way of dealing with these problems, the Swedish approach seems to focus pragmatically more on environmental objectives and safety standards and devotes greater attention to the needs of disadvantaged road users. The social sciences, a traditional strength in Sweden, play a major role. Swedish transport research addresses the topics of safety, environment, and future technologies. The independent Swedish local authorities conduct their own environmentally ambitious transport projects, which are scientifically grounded political decisions promoting informed efforts to help the environment.

Zusammenfassung

Der schwedische Staat fördert massiv die Sicherung der internationalen Wettbewerbsfähigkeit der nationalen Wirtschaft und Industrie. Die Verkehrsforschung in Schweden befindet sich dementsprechend in einem permanenten strukturellen und thematischen Veränderungs- und Anpassungsprozess. Da Schweden ein Land mit einer eigenen Fahrzeugindustrie ist, werden umfangreiche und kostenintensive Forschungsprogramme zur Fahrzeugentwicklung in Kooperation von Industrie, Forschung und Staat aufgelegt und zum größeren Teil vom Staat finanziert.

Die politische Steuerung der Akzentsetzungen in der Verkehrsforschung scheint leichter als hier zu Lande, da es eine Aufteilung von Kompetenzen zwischen dem Bund, den Ministerien und den Ländern in Schweden so nicht gibt. Insgesamt ist Schweden im internationalen Vergleich sowohl in der angewandten Verkehrsforschung als auch in der Grundlagenforschung innovativ. Dies korrespondiert nicht zuletzt mit den ambitionierten Zielen der Verkehrspolitik. Die „Vision Zero", das langfristige Ziel keine Verkehrstoten mehr zu wollen, ist dabei ein herausragendes Leitbild.

Auch Schweden hat die bekannten Probleme mit den Folgen der Massenmotorisierung. Im Unterschied aber zu Deutschland wirkt der Umgang mit diesen Problemen stärker und pragmatisch an Umweltzielen und Sicherheitsstandards ausgerichtet, wobei den Anforderungen schwächerer Verkehrsteilnehmer/innen mehr Beachtung geschenkt wird. Hier spielt die starke sozialwissenschaftliche Verkehrsforschung eine wichtige Rolle. Die Themen der Verkehrsforschung insgesamt sind Sicherheit, Umwelt und Zukunftstechnologien. Die unabhängigen schwedischen Kommunen führen eigene, umweltpolitisch ambitionierte Verkehrsprojekte durch, die die wissenschaftlichen Anstrengungen unterstützen und umgekehrt auch verkehrswissenschaftlich begründet werden.

Table of Contents

1. Introduction

This inquiry into Swedish policy on transport research is part of the "Study on Strategies, Programs, and Projects Pertaining to Policy on Transport Research in Selected European States, the United States, and Japan" (short title: "SmartBench"), a project funded by the Germany Federal Ministry of Education and Research. The European countries covered are Great Britain, The Netherlands, France, Switzerland, and Sweden. The project was launched in August 2002 and completed in July 2004. It involved the cooperation of the Project Group on Mobility at the Social Science Research Center, Berlin (Wissenschaftszentrum Berlin für Sozialforschung, WZB), the Forschungs- und Anwendungsverbund Verkehrssystemtechnik Berlin (FAV), the German Aerospace Center Institute of Transport Research (Institut für Verkehrsforschung des Deutschen Zentrums für Luft- und Raumfahrt, DLR), the Center for Technology and Society at the Technical University of Berlin (Zentrum Technik und Gesellschaft an der TU Berlin, ZTG), and the Institute of Geography at Humboldt Universität in Berlin (Geographisches Institut der Humboldt-Universität zu Berlin).

The objective of this undertaking is to identify successful research programs, initiatives, and projects outside Germany and to make them available and useful for German transport research. The factors determining their success are discerned through examination of German policy on transport research and comparable policy in the countries studied. Data in the countries being compared were gathered, described, and evaluated together with the participating national colleagues, a procedure that facilitated consideration of the conditions prevailing in their countries. The results are being collated in final country reports, with the Project Group on Mobility focusing on Japan and Sweden.

The present report begins by depicting the basic conditions and objectives of Swedish policy on transport research. It also throws light upon the Swedish transport market in order to explain the background of the political decision-making process behind Swedish transport research. The subsequent section shifts attention to the structures of and changes in Swedish transport research and explores its context.

To gain perspective on the projects and programs of transport research, it proved purposeful to investigate the institutions that fund research. They play a key role in the planning and implementation of Swedish transport research. The most important ones are selected and presented in this report. Because the quality of Swedish transport research derives from the training of young scholars at Swedish colleges and universities, one section concentrates on that training and its strengths. A report on transport research in Sweden would be incomplete if it did not give due space to social science transport research and the topics it treats. The same is true for Sweden's municipalities, which not only pursue novel transport policies but also act on research results. The activities engaged in by the city of Gothenburg are held up as examples of innovations in transport policy and environmental policy.

This report concludes by looking at how the objectives of Swedish transport research are actually put into practice, whether there are any special Swedish features or innovative project ideas, programs, and structures, and whether the results of this study are transferable to and seminal for German transport research.

For the interim report and final report on Sweden, the most valuable sources of information were the Internet and the 24 interviews conducted with transport experts primarily in Sweden and in Hamburg and Berlin.[1] Further details are available by e-mail.

We are grateful to Professor Lars Sjöstedt (Technical University of Hamburg-Harburg), speaker of the European Center for Transport and Logistics,[2] and to Dr. Maria Johansson, Lund University, Environmental Psychology Unit, Lund Institute of Technology,[3] for their reports, comments, and practical support.

[1] See the list of interviewees, Enclosure 1. For a list of literature and other sources, see Enclosure 2.

[2] Professor Lars Sjöstedt and MBA Jan-Erik Gasslander (2003), "Overview of the Swedish research funding system with special accentuation on programs for transportation and logistics," 7 July 2003, unpublished manuscript, Wissenschaftszentrum Berlin für Sozialforschung, Research Area on Organizations and Knowledge, Research Unit on Innovation and Organization.

[3] Dr. Maria Johansson (2003), "Behavioural science perspectives in Swedish transport research: Preliminary report to the Social Science Centre in Berlin," unpublished manuscript of 7 July 2003, Wissenschaftszentrum Berlin für Sozialforschung.

2. Framework and Objectives

Sweden has an area of 173,732 square miles (just under 450,000 square kilometers), compared to Germany's 139,000 square miles (or about 360,000 square kilometers). The landscape is fairly flat, and the geography is dominated by numerous inland lakes, a host of coastal islands (skerries), and, in the Baltic Sea, the large islands of Gotland and Öland. Of Sweden's 8.8 million inhabitants (a good tenth the size of Germany's population), 83 percent live in towns, the corresponding figure in Germany being 88 percent. Sweden's central and northern regions are thinly populated, and the country as a whole has a population density of 8.5 inhabitants per square mile (22 per square kilometer) as opposed to Germany's 89 per square mile (231 per square kilometer). Sweden is subdivided into 24 counties (*län*), including the three biggest cities—Stockholm (743,000), Gothenburg (462,000), and Malmö (257,000).

Sweden has been a constitutional monarchy since medieval times. The first Swedish *Riksdag* (parliament) was convened in 1435. In 1809 the power of the king was restricted, and in 1866 the four-chamber parliament was reformed into a bicameral body. Sweden's present unicameral parliament dates from 1971 and has 349 members. The current head of state, King Carl XVI Gustaf, has reigned since 1973; the social democratic prime minister, Göran Persson, has held office since 1996.

Sweden's social and political system is marked by small ministries, a strong, independent municipal government, and a policy style oriented to cooperation and consensus. The office of Ombudsman is an original Swedish institution. It is a small, autonomous supervisory body acting in the public interest. There is a justice ombudsman, a consumer ombudsman, and an equal-opportunities ombudsman.

Sweden currently allocates 3.8 percent of its GNP to research and development (R&D), more than any of the other 28 members of the OECD. Research by industry accounts for 75 percent of this funding. The remaining 25 percent goes to university research. There is relatively little funding available to the government and ministries for their own R&D.

2.1 Objectives of Transport Policy

In 1998 the Swedish parliament passed legislation[4] that is still the basis of official transport policy. The law stipulates that transport policy shall contribute its share to socially, culturally, economically, and ecologically sustainable development. The objectives of transport policy are to create an accessible, quality transport system; provide safe transport ("Vision 0"); protect the environment; foster regional development; avoid gender bias in serving customers; and meet the requirements of people with disabilities.

[4] Government Bill 1997/98: 56.

Road and railroad users should have the widest possible freedom to arrange for safe, environmentally sound, and reasonably priced transport. Improved cooperation between the various means of transport is combined with effective competition between different transport providers. Decisions affecting transport issues are to be made as decentrally as possible, with a clear distinction between the roles of the diverse planning levels and actors. The vision of integrated transport is not explicitly formulated in Sweden, it is a part of transport planning.

Swedish transport policy has set extremely high goals. The political intention behind "Vision 0," the spectacular target announced in 1996, is to eventually reduce the number of traffic fatalities in Sweden to zero. Although the average annual toll remained unchanged at 550 for years thereafter, a shift in the trend seemed to occur as of mid-2002. In 2003 "only" 496 road and rail fatalities a year were reported in Sweden, the lowest number since 1950. This development could be due to waning economic growth and to the effectiveness of road safety measures. The political objective is to scale back the number of annual traffic deaths to 270 by 2007.

For historical reasons, safety has long been an important subject in Swedish transport policy and management. Sweden has not waged war since 1809, so the country has no disabled veterans. After so long a period, it may have come as a shock to be confronted again by casualties—those from rapid growth in transport after World War II and the attendant increase in the number of road and rail accidents. The consequences of automotive transport were not socially accepted. This response quickly gave rise to the creation of an independent research council on traffic safety. In addition, the switch from left-hand to right-hand traffic in 1967 gave policy-makers and government officials a unique opportunity for the selective introduction of speed limits on expressways and highways, control measures hitherto unknown in Sweden. This change was accompanied by the creation of a scientific commission whose comparatively generous budget enabled it to involve many researchers from a variety of disciplines.[5]

When it comes to safety, the Swedish automotive manufacturers, producers of accessories, and municipalities have traditionally been highly active and innovative in dealing with the familiar critical factors in accidents: drunk driving, speeding, and fatigue.

Sweden has the same transport-related problems as Germany does: environmental impacts, area lost to motorized private and delivery transport, lack of parking space, and accidents. As pointed out above, Sweden, unlike Germany, is sparsely populated, especially in its central and northern rural regions. The country's transport infrastructure is correspondingly very thin, and the climatic conditions are comparatively harsh. However, Sweden's fleet of buses for people with disabilities is striking. Kneeling buses are standard in Sweden. Conditions with rail transport, whether in the passenger trains themselves or in the subway stations and intercity train terminals, appear to

[5] See Professor Sjöstedt's review (18 October 2004) of this report, unpublished paper, Wissenschaftszentrum Berlin für Sozialforschung, Research Unit on Innovation and Organization.

be no better than in Germany. Access is difficult. For out-of-town travelers, signage about location and departure times for intercity trains is especially problematic. The road system, however, has many streets with bicycle paths.

2.2 The Development of the Swedish Transport Market

The transport market in Sweden has been developing positively for years. An example is the situation with passenger and freight transport. In 2000, total passenger transport in Sweden reached its highest level ever: just over 5 billion person-miles (8.3 billion person-kilometers). The number of passengers in the province of Skåne (the southernmost part of Sweden) surged by 50 percent after the opening of the Øresund bridge, which connects Denmark and Sweden. Passenger traffic across the bridge is 40 percent more than expected. The number of trips by rail, that is, with the Swedish State Railroad Company (*Statens Järnvägar*, SJ) and the other providers, rose by nearly 35 percent, from 26.5 million in 1997 to 35.7 million in 2002. The number of person-miles followed a similarly upward trend, rising just under 17 percent,[6] from 5,062 person-kilometers in 1997 to 5,920 person-kilometers in 2002. This growth in passenger transport, however, had no effect on the modal split, which remained at a 7 percent share of the market.[7]

The volume of transported freight also reached the unprecedented level of 19.9 billion ton-kilometers. In this area, Sweden has traditionally achieved a much more advantageous modal split than most of the other European countries because of the special transport measures it has implemented. The railroads in Germany handle 14.6 percent of the long-haul freight (distances more than 62 miles, or 100 km) in terms of ton-kilometers, whereas the movement of freight by road account for 69.5 percent.[8] The corresponding figures for Sweden are 25 percent for the railroads and 37 percent for roads.[9] In both countries, the rest of the freight is transported by air and sea.

This development is attributed to the reforms that Sweden's transport market has been undergoing since the 1960s.[10] The Transport Act of 1963 was a prelude intended to promote the efficiency of business management by separating economical from uneconomical networking. The idea was to encourage this change by broadening SJ's latitude for pricing and timetables.

Motivated by the burgeoning deficits in public transport, the Swedish government launched the regionalization of local public transport by passing the Transport Act of

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[6] Statens Järnvägar (2002).
[7] Banverket (2002), p. 13.
[8] Bundesministerium für Verkehr, Bau- und Wohnungswesen (German Federal Ministry of Transport, Construction, and Housing) (2003). *Verkehr in Zahlen 2002/2003*. Berlin: Deutsches Institut für Wirtschaftsforschung (DIW).
[9] Banverket (2002), pp. 12–13.
[10] Oliver Schöller and Anke Borcherding (2004), "Elchtest. Die Reform des staatlichen Eisenbahnsystems in Schweden," *Internationales Verkehrswesen*, 56(5), 188–191.

1979. Regional transport consortia (*trafikhuvudmän*) were set up in the 24 counties and organized by the regional transport bureaus. The task of these consortia was to hone local public transport's responsiveness to local needs. The standardized process for subsidization was refined, with the result that selective funding could be keyed to local demand. Transfer of accountability to the local institutions led to constant adaptation to local conditions, enabling municipal authorities to decide for themselves how to use the funds allocated to them.

For the first time, SJ was granted full discretion over its budget so as to facilitate flexible development of its quality standards. The franchises, however, remained with the transport authorities, a link that initially precluded real competition. Regional and municipal grants to cover operating costs continued to swell in the following years. To reverse this trend, genuine competition for transport services has been sought since the late 1980s.

The passage of the Transport Act of 1988 seemed like a silent revolution to contemporaries. The franchises of the transport companies were transferred to the regional transport bureaus, which thereby acquired their first opportunity to call for competitive bids on transport services. This approach functionally separated clients from producers.[11] A momentous step in the railroad industry was the creation of a railroad infrastructure company (*Banverket*) for the entire rail network, which had hitherto been part of SJ.[12] Divestment of unprofitable infrastructural services was intended to give SJ the chance to calculate independently in line with the market. Branch, or secondary, lines were opened up to competition at the same time. Provision of services on the main lines was initially reserved for SJ alone. However, the act of separating operations from infrastructure prepared the way for introducing competition in the railroad sector.

Deregulation came in the late 1980s. On 10 January 2000, the main lines—SJ's prerogative—were opened to the market, formally ushering in the liberalization of Sweden's rail transport. In reality, however, the market for rail passengers is still divided into three segments, and SJ's monopoly has not ended. Profitable interregional rail lines are still run only by SJ. Unprofitable interregional lines are operated by a public authority known as *Rikstrafiken*. Regularly scheduled regional service is offered by the regional transport authorities. Liberalization has split SJ into six different companies, with SJ being in charge of passenger service. At the end of 2002, SJ found itself in serious economic trouble from which it was rescued only with grants-in-aid from the government.

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[11] See also Technical University of Berlin (2004), *Synetra: Synergien zwischen Bahnnetz und –transport. Praxis, Probleme, Potentiale* [Synetra: Practices, problems, and potential related to synergies between rail networks and rail transport]. Berlin: Technische Universität Berlin, pp. 232–250.

[12] Interview with Malcom Lundren, coordinator of the research department of the Banverket, 1 April 1002, Borlänge, Sweden, with Jan-Erik Gasslander representing Lars Sjöstedt.

Two important indicators of deregulation's social effects are the development in the number of jobs and the development of wages. The number of jobs in the railroad industry has fallen steeply since the beginning of deregulation—from 36,000 in 1988 to 20,000 in 2002.[13] In the early years of the reform, "labor displacement" was accompanied by special programs accepted by both labor and management. "Of the 21,000 people employed by SJ in 1990, 11,000 remained by 1999, a decline of 46 percent."[14] Deregulation has evidently not affected income levels, aside from the cancellation of benefits that government employees otherwise receive. However, employment conditions have become more flexible than they used to be, leading to irregular working hours and a rising total number of working hours per day. Accordingly, most observers assert that deregulation measures have adversely affected the working conditions of the employed.[15] The picture is contradictory in customer services, too. On some lines, customer service seems to have improved with the gain in the number of passengers; on other lines, customer service has deteriorated perceptibly. Passenger information and the different fare schedules of the providers clearly pose problems, an issue the state is to eliminate through regulation.

Unlike the case in Britain, deregulation has not been associated with any decline in safety. The number of transport-related fatalities and severe injuries in Sweden fluctuated in the 1990s, and the trend has clearly been downward as of 2000.[16]

As a result of all these factors, the demand for rail services during peak traffic hours is often higher than the supply. Moreover, the transport figures for freight is declining in some thinly populated rural regions.

On the whole, experts in Sweden view the deregulation of the railroads positively, especially for rural areas. Generally, regional providers handle passenger transport in the rural areas. In this context, deregulation has led to investment possibilities that these providers have used, and it has raised the quality of the services offered. The operating costs in this segment of the industry have dropped by as much as 30 percent.[17]

The prime objective of the market reforms in rail transport—to relieve the budget of the Swedish government—has not been achieved yet, however. In the ten years since deregulation, state spending has nearly quadrupled, rising from a net €302 million in 1985 to a net €1.1 billion in 1995. From 1996 through 1999, the share of Banverket's total proceeds accounted for by government subsidization went from 67 percent to 72 percent.[18] SJ will henceforth try to solve its financial straits by investing in efficiency and diminishing its production costs.

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[13] Banverket (2002), p. 12.
[14] ÖGPP (2002), p. 24.
[15] Ruiter and Mast (2000), p. 14.
[16] SIKA (2003).
[17] Unfried (1994), p. 4.
[18] ÖGPP (2002), p. 25.

In November 2003, the railroad commission (*Järnvägsutredningen*) that the Swedish government set up in 2001 to make suggestions for laws implementing EU railroad regulations proposed doing away with the monopoly that SJ and the regional providers had on nationwide rail lines. Consequently, a decision is needed on how to continue dealing with the separation between the public rail network and what will probably be privately run operations.

3. Swedish Transport Research: Structure and Change

Transport research in Sweden has traditionally been funded by the Ministry of Transport and Communication. The first research agency, the Traffic Safety Council (*Trafik*säkerhetsrådet), which was created in 1960, supported research only in the field of traffic safety. Over the years, its mandate was broadened, and its name was changed to Transport Research Board (*Transportforskningsberedningen*, TFB). In 1990 it was also put in charge of telecommunications and was renamed accordingly: *Kommunikationsforskningsberedningen* (KFB).

In 2000, the structure of publicly funded research was radically reformed in Sweden to sharpen attention to meeting the demands of the economy, treating practical problems, and producing useable results. The effort led to the creation of *Vinnova*, the Authority for Innovation Systems, which controls the bulk of publicly funded transport research.

3.1 Fund System and Research Foundations

Since the 1980s, Sweden's research policy has been influenced primarily by a funding system established by a parliamentary resolution passed while Olof Palme was Prime Minister. This wage-earners' fund (*Löntagarefonder*) was set up in 1984 by the social democratic parliamentary majority. All sizable Swedish firms paid part of their net profits into the *Löntagarefonder* in order to purchase shares. The profits from the fund were earmarked for use to advance Sweden's economic development.

The opposition parties saw this arrangement as a creeping process of socialism. When they came to power under the conservative government of Prime Minister Carl Bildt in 1991, they decided to dissolve the *Löntagarefonder*, which by that time had amassed a value of approximately €2 billion. Of this amount, €72 million was made available as venture capital for small business. The sum of €110 million was used to found Chalmers University of Technology, Gothenburg, and the University of Jönköping as independent foundations and to set up two research foundations, one for strategic environmental research (MISTRA) and the other for strategic research (SSF). A boom in the stock market left an additional €55 million to €110 million for the creation of six other foundations.

Politically, this structure did not suit the Social Democrats, who were reelected in 1994. Opposed to the foundation concept but unable to change it, the government ensured its influence through the composition of the supervisory board. This leverage enabled the government to coordinate the allocation of the funds with state-funded research.

In addition to these foundations, the Volvo Research and Training Foundations are important in Swedish transport research. They were created in 1987 to promote research and training in the areas of transport, energy consumption, and industrial development. Interdisciplinary projects have priority. To date, this technical, transport,

and social science research has attracted investment of $20 million. Since 2000, the Volvo Foundations have focused their activities on "future urban transport." The intention is to establish a high-quality research and training program aimed at upgrading the accessibility and efficiency of the transport system and at fostering the sustainability of the environment and society. The leading topic is the complexity of developing urban transport. For this purpose, the foundations are instituting "centers of excellence," funding many small international research projects, offering two-year postdoctoral scholarships, and holding international conferences.[19]

3.2 Reorganization of the Funding Structure

At the start of the new millennium, preparations began for reorganizing the landscape of Swedish transport research. The goal was to adapt Sweden's decentralized research structures to the centralized structures of other countries and to defend Sweden's standing within international research by concentrating on major research projects. When Vinnova was founded in 2001, the organizations that had hitherto controlled research on transport and logistics were abolished.

Now that a few years have passed in the reorganization and initial familiarization with the new structure, actual practice in transport research has drawn criticism from some Swedish experts in that area.[20] Changes that have taken place in recent years could, they contend, eventually erode the quality of basic research. These specialists also deplore both the turn to research designed to yield quickly exploitable results and the fact that research budgets have shrunk.

The period from 1994 through 2002 is regarded as a "lost decade" for research programs on transport and logistics. Money continued being invested, albeit at a declining rate, in "old" programs and established groups. Research on transport and logistics had no priority in either Vinnova or the newly created foundations. Vinnova more or less inherited the programs from its three predecessors and showed little initiative to develop new ones.[21] Transport researchers were urged to form groups and seek funding for big projects. They were unsuccessful. In the 1990s there was keen interest in information and communications technologies and the attendant research. Transport research was largely "invisible."

The status of transport research in Sweden in 2004 is thus contradictory. The creation of Vinnova ushered in a basic change in research funding. Transport research is only one of several areas supported by Vinnova. Funding for transport research has dwindled, and no new sources have materialized. The research council, *Ve-*

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[19] www.volvoresearchfoundations.com

[20] Interviews with Professor Lars-Göran Mattsson, 31 March 2003 and 31 March 2004, Stockholm, Sweden; Professor Arne Jensen 2 April 2003, Gothenburg, Sweden; Dr. András Várhelyi, 4 April 2003, Lund, Sweden; Professor Per Lövsund, 2 April 2003, Gothenburg, Sweden; and Dr. Stig Franzén , 2 April 2003, Gothenburg, Sweden. (See Enclosure 1, "Interview Partners.")

[21] Statements by Professor Lars Sjöstedt in his previously cited unpublished report.

tenskapsradet, does fund basic research at universities and institutes, but not transport research. What is more, the reorganization of research has led to discontinuities in the process of defining topics and the thrust of research. Thematic overlaps, for example, have disrupted efforts by Vinnova and Vägverket, the Swedish road authority, to plan centers of competence (VINN X 2003). For clarification, the Transport Committee of the Swedish parliament is preparing a review of the state of the art in transport research not only in Sweden but also in other countries. Vinnova is conducting parallel evaluations and advancing recommendations for the future direction of Swedish transport research.

The sheer abundance of research projects still seems to complicate the decision on which ones to back. Their proliferation may be the result of the decentralized structure, which has been faulted for having too many actors and too little coordination. Eight of every ten submitted research proposals are rejected.[22] The existing intricate structure also comes across as an obstacle to acquiring EU projects.

Policy-makers[23] reprove the lack of a master program with a national and political objective and a holistic perspective on the transport system. One grievance of the politicians responsible for transport in the Swedish parliament is the lack of influence they have on Vinnova, which answers to parliament's Science Committee, not the Transport Committee.[24]

Vinnova's approach has its strengths, too, however. All projects must be multidisciplinary, a stipulation that serves cooperation between universities, the business community, public institutions, and research centers. It brings a variety of interests and methods together and at least decreases the danger of research projects drifting into academic insignificance or a purely industrial orientation.

3.3 The Swedish Public Authorities

In Sweden, the regions (*län*) hold sole responsibility for all planning procedures. Although certain projects must be coordinated with the central government in Stockholm, the regional authorities are the most important executive powers.

Swedish public authorities have been independent for four hundred years. These institutions are characterized by a flat organization. They report to supervisory boards and general directors. The government has only indirect influence on the public authorities through its appointments of their directors and the members of the super-

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[22] From an unpublished manuscript on a survey among decision-makers from public administration, business, and the research community on the subject of the Vinnova reform, Ministry of Industry, Employment, and Communication [2004]. See also Vinnova's evaluation report on national strategy in transport research, www.vinnova.se

[23] Interview with Claes Roxbergh, Chair of the Transport Committee of the Swedish Parliament, 31 March 2004, Stockholm, Sweden.

[24] Interview with Göran Nyström and Hélèn Tegnér, Office of the Transport Committee of the Swedish Parliament, 31 March 2003, Stockholm, Sweden.

visory boards. The government controls the public authorities principally by means of "regulatory letters" (*Regleringsbrev*) and ordinances. The letters define the objectives that the public authorities are expected to achieve through their actions. They also contain the annual budget.

A few public authorities have sectorial authority over financing research at universities and other specialized institutions in their area. Vägverket performs this function for roads; Banverket does so for the railroads.

The public authorities prepare applications for project funding (*äskande*), which must be bargained over politically. In annual budgetary negotiations, the government asks what public authorities require. The finance ministry submits to parliament a budget proposal, which is decided upon after deliberation by the parliamentary committees (*utskott*). Funds, including those for transport research, are thereby allocated directly to the public authorities. Vinnova's budget is set in this way. The Ministry of Industry, Employment, and Communication and the Ministry of Education are jointly responsible for transport research.

In order to present relevant research programs and to cover annual budget requirements, each public authority has a research advisory board with representatives of the policy-making community and industry. Their chief products are research programs that facilitate the budgetary negotiations and guide decisions on the submitted research proposals, which are considered annually or semiannually. Researchers still have relatively wide latitude to determine the size and aims of the research projects within these programs. A sound reputation and well-founded research proposals are important for approval to run research projects.

The public authorities must disclose their expenditures to the government and organize open, competitive bidding. The public authorities transfer the research funds directly to the research centers of the universities and to private consultants after the research proposals have been scrutinized. For substantial projects, this task is entrusted to three evaluators, usually foreign professors.

There is no external controlling or project management by the public authorities and the research centers as the research is conducted. Sweden has no institution such as Germany's Technical Control Board (TÜV). The only formal instrument for exercising control is the rejection of project funding. The *Riskrevisionsverket* is the sole agency in charge of official controlling, a function that imbues it with a fair degree of power.

SIKA,[25] the Swedish Institute for Transport and Communications Analysis, founded in 1995, reports to the Ministry of Industry, Employment, and Communication. The institute analyzes data to supply a basis for planning by actors in the area of transport and communication. For this purpose the institute receives statistics, descriptions of the current situation, and forecasts. Among other things, SIKA prepares studies for the

[25] Interview with Inge Vierth and Göran Friberg, SIKA Institute, 29 March 2004, Stockholm, Sweden.

government, compiles the official statistics on the transport and communications sector, and develops forecasting and planning methods. The institute also evaluates the costs of transport to answer such questions as how much money it would take for accident-reduction measures to curb the number of road and rail fatalities. SIKA is a small organization with influence on the research projects. It works closely with Banverket and Vägverket. For example, the project that developed Sampers (a computer-aided traffic-forecast system and tool that models demand for all travel in Sweden) was headed by SIKA, funded by Banverket and Vägverket, and conducted by a private consulting company.

3.4 Progress Report

The conditions surrounding Swedish transport research have changed over the last twenty years, depending on the government's political strategy. There have been only two different directions, though: mostly social democratic, sometimes conservative. The foundations, which had been suspected of socialist leanings because they siphoned off some of the profits earned by the major companies, were dissolved or transformed by a conservative government. In any case, direct subsidization off general welfare was ended. The structures have always been changed to bring them into line with national and international economic developments. The intention has been to make the Swedish economy fit for globalization and to expand its role in intra-European competition for EU funding. One priority has not shifted, however. The emphasis on safety, so evident from the Volvo of the 1960s and from the research commissioned by the Traffic Safety Council at that time, is still the basis of transport research in Sweden.

Of course, much of Swedish transport research consists of automotive research or research in the service of vehicles and roads. The Swedish car manufacturers and their network employ 250,000 people and post turnover ranging from €30 billion to €50 billion.[26] The high objectives of Swedish transport policy have thus far survived these constant changes. They are part of the country's political culture and constitute the foundation for adapting topics and structures of transport research.

[26] www.pff.nu and from an information brochure entitled "The Program Board for Automotive Research—PFF—and Its Work," May 2004 (received by e-mail on 15 September 2004 from Gunnar Lindstedt, the person responsible for PFF at Vinnova (hereafter cited as *PFF and Its Work*).

4. Focal Points of Research Funding

The main areas of transport research in Sweden are safety; environmentally sound automotive engine technologies; and user behavior, especially that of children, older persons, people with disabilities, and beginning drivers. Technical systems for directing traffic and monitoring speed are tested. In research on rail transport, priority goes to logistics and the movement of freight by a combination of rail and road systems.

Swedish municipalities (e.g., Gothenburg, Lund, and Stockholm) have an important role in conducting innovative projects pertaining to transport policy. Indeed, Gothenburg's efforts in the field of mobility and urban transport policy led to the community's being named "CIVITAS City of the Year" at the CIVITAS FORUM 2004 in Rotterdam (17–19 November 2004). The primary actors deciding the subject matter of the projects and acquiring the funding are Vinnova,[27] Vägverket, Banverket, and the Swedish National Energy Agency, Energimyndigheten (STEM), for they define the research topics and call for the competitive bids. The universities and institutes apply for research funding.[28]

4.1 *Vinnova*—The Authority for Innovation Systems

Vinnova[29]—The Authority for Innovation Systems (Verket för innovationssystem)—is headquartered in Stockholm, employs 145 people, and is the most important source of research funding. Vinnova's job is to initiate and support R&D needed in the fields of technology, work life, and transport. Vinnova has five scientific platforms: biotechnology, effective product development and materials, work life, information technologies, and infrastructure and effective transport systems. Research on transport receives annual funding of €160 million. Vinnova's projects must be of a strictly applied and practical nature. Two of the eighteen areas of growth that Vinnova has defined have to do with transport: innovative vehicles and systems, and innovative logistics systems and freight transport.

Competence Centers

Vinnova already has an on-going program of competence centers, which was launched by its precursor, KFB, with 28 centers at 8 universities. The competence cen-

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[27] Unfortunately, details about the duration and funding of some of the projects that have been presented are unreliable. The information published by the responsible authorities is often contradictory and thus precludes total precision in this presentation.

[28] The programs described in this report are from a presentation given by Vinnova on 1 April 2004 as transmitted by e-mail on 3 August 2004 by Gunnar Eriksson of the Swedish Ministry of Economics; from the website of the Program Board for Automotive Research (PFF), www.pff.nu, and *PFF and Its Work*.

[29] Interview with Joakim Tiséus, head of the transport department at Vinnova, 31 March 2003, and Carl Naumburg, Vinnova, 29 March 2004, Stockholm, Sweden.

ter for railroad mechanics, "Charmec," is clearly associated with transport. It involves nine partners, including universities, Bombardier, and Green Cargo (a former government society for freight rail transport). The competence centers bring together the authority and the R&D needs of the universities, industry, and the government in order to conduct demand-centered, problem-oriented projects in defined areas and time frames.

Three new competence centers (VINN X) planned in 2004 are to have a life of ten years, each with a budget of €2 million supplied by the government, universities, and business to treat the topics of freight transport and logistics, innovative vehicles, and transport policy. The new competence centers thereby respond to the escalating need for research-based knowledge and to the increasing dependency of companies, public actors, and other organizations on external competence, research cooperation, and development. At the same time, costs and the need for efficiency are forcing the different companies to concentrate on their core activities in R&D. The new generation of competence centers will therefore accentuate an "innovation perspective" and sustainable growth more than their predecessors did.

This aim, which is in keeping with Vinnova's mandate, is to foster a strong orientation to the market and to international competition. To help businesses adapt to changing world market conditions and to aid companies where R&D is going abroad, the idea is to create a sound environment for research and innovation, that is, an effective interplay of production and competence networks with qualified researchers and education in the key areas. Small companies, which often do not reach critical mass in research volume, are also supposed to benefit. By using public funds and by networking the activities of the business community, public institutions, universities, and research centers, this approach ultimately ought to enhance the returns on R&D as far as Sweden's international competitiveness is concerned.

Public Transport

The principal goal of the projects funded by Vinnova in this topic area is to increase the use of public transport. Public means of transport are often criticized for being complex and bewildering to use. People also fear a loss of control over their own route. To overcome these barriers, the search is for research projects that make the access to public transport attractive and comprehensible to potential customers by identifying the information they want and the appropriate technologies with which to supply it.

The greatest current issue with passenger transport on demand—the integration of call buses into regular public transport, for example—is the absence of standard ways to furnish information about and make arrangements for the entire journey. Solutions that seem user-friendly and effective are being tested.

Mobility of Older Persons and of People with Disabilities

Politically and practically, the mobility of older persons and of people with disabilities is a subject with a long and successful tradition in Sweden. Kneeling buses and other measures to ensure the accessibility of public transport are a normal part of everyday life in Sweden. There are also alternative modes of transport, such as the customary driving services offered in Germany to people with disabilities. The costs of these services, however, are estimated to be high, even excessive. Projects on ways to facilitate this group's access to regular public transport are therefore conducted.

Infrastructure

According to calculations by Vinnova, maintaining the infrastructure will require €42 billion in the next ten years. The research program on "infrastructure and efficient transport systems," which was launched in 2003, will continue through 2007 and has funding of €16 million to €17 million. The research questions are general: How can the transport system be improved so as to encourage national and regional economic growth more efficiently than in the past? How should the planning, organization, development, operation, and funding of the transport infrastructure be shaped? What should the urban transport system look like? How should public transport be promoted? Approximately 50 projects are being conducted as part of this program.

Transport Policy

The objectives of transport policy are extremely high in Sweden. The momentous waves of innovation seem to have passed, or measures have already acted upon them. The Swedish agenda evidently has no new, innovative topic capable of stimulating German transport policy, too. This program area at Vinnova seems correspondingly uninspiring. Known projects are being monitored and evaluated and certain analytical tools are being developed.

Scientific preparations based on extensive data are preparing the way for the introduction of the congestion pricing already familiar in London, a measure that will be monitored and evaluated. The project is scheduled to begin in 2005 in Stockholm. The long-term objective is to analyze the impacts that the road toll has on traffic. Another project deals with the effects that the construction of the Øresund bridge has had on regional development. A vast amount of data is being collected and analyzed for this purpose, and procedures for forecasting developments in traffic are undergoing examination. A third project is about the development of analytical tools for measuring the effects that investments in infrastructure have on local labor markets.

Transport in Rural Areas

The organization of public transport in rural areas is a special, costly problem in Sweden because of the geographic conditions involved. For this reason, comprehensive public transport of passengers is no longer the only mode of travel available. Private alternatives (including passenger cars) and transport on demand are sought. Projects testing and evaluating "small solutions" of this sort are therefore being funded.

Logistics and Freight Transport

Vinnova runs a program on "innovative logistics and freight transport systems," which was launched in 2003 and will continue through 2007. It has a budget of €13 million to 15 million, 50 to 70 percent of which comes from the government and 30 to 50 percent from industry. This program ensued from the relatively high costs of logistics in Sweden. It is hoped that optimization of logistical skills will enable Swedish companies to establish customer-centered supplier networks for the global market despite the country's peripheral location. This program is intended to meet industry's demand for quick research results and easy access to researchers. This program has given rise to around 50 projects.

Network and the Program Board for Automotive Research (PFF)

The Swedish automotive industry produced approximately 745,000 vehicles in 2002. About 280,000 of them were of domestic manufacture, and 25,000 of those were trucks. In addition, basic components for about 100,000 transport vehicles are produced in Sweden. They are subsequently assembled in other parts of Europe.

Most of this production—85 percent of the cars and 95 percent of the trucks and buses—is earmarked for export. This export of automotive vehicles and their components reached a value of €12 billion in 2002, accounting for 14.1 percent of Sweden's total exports. The automotive industry represents 25 percent of the country's trade balance. From 1974 to 2002, the export of automotive vehicles and components rose by a factor 3.3, from €3.7 billion to €12 billion (in 2002 prices).[30]

The two following programs are part of the "Network and Program Board for Automotive Research" (PFF), which was created in 1994 by the Swedish automotive industry (AB Volvo, Saab Automobile AB, Scania CV AB, and the Scandinavian automotive suppliers), Vinnova, Vägverket, STEM, and the National Nature Protection Agency as an agreement to cooperate. The program is directed by an independent chairperson appointed by the government. The objectives of the PFF are to simplify the coordination of R&D in the area of automotive technology. The PFF is also intended to serve as a forum for the discussion and analysis of current issues within the automotive sector.

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[30] *PFF and Its Work*.

Four automotive research programs have emerged from the PFF: the vehicle research program (ffp), the Green Car Initiative (Gröna Bilen[31]), the emission research program (EMFO), and a program on intelligent vehicle safety (IVSS). The programs are presented in the following sections about the authorities responsible for each of them.

Innovative Vehicles and Systems

The intention of Vinnova's €77 million ffp research program (1994–2004) is to promote the sustainable growth and strengthen the competitiveness of the Swedish automotive industry and all types of transport through high-quality research on safety, the environment, and the cost–quality ratio.

The Green Car

The PFF conducts the "Green Car" research program (2000 through 2005) on a budget of approximately €200 million, of which 30 percent comes from government sources, 70 percent from industry. Its 80 projects consist of an R&D program and a training agreement designed to raise the number of university graduates specialized in automotive vehicles. The goal is to develop environmentally friendly passenger cars, buses, and trucks. The foremost research interest lies in engine technology, emission research, and hybrid and fuel-cell vehicles. Detailed work is being done on methane-gas engines, the recycling of emissions, hybrid and fuel-cell technology, intelligent transport services (ITS), and weight reduction.

Basic Researchers' Criticism of Vinnova

Not surprisingly, Vinnova is controversial among the transport researchers at the universities in Sweden.[32] They state that transport is a marginal topic for Vinnova and that setting up Vinnova brought Swedish transport research to a standstill for two years. In the opinion of these experts, the high-quality Ph.D. training in Sweden, fostered by KFB, is jeopardized by Vinnova because there is the agency has no interest in basic research, only in results that can be used quickly. Consequently, the fear is that Sweden will begin to lag in basic research. These specialists assert that the universities have trouble acquiring funds for transport research and that Vinnova has not found the important focal points of the research for the next decade. The researchers interviewed about this topic contend that the areas underlined seem to be decided upon rather randomly. When evaluating the research projects, they say, Vinnova considers only the priorities that it has defined itself. In the view of these critics, the

[31] www.gronabilen.se

[32] Interviews with Professor Mattsson (31 March 2003 and 31 March 2004), Professor Jensen (2 April 2003), Dr. Värhelyi (4 April 2003), Professor Lövsund (2 April 2003), and Dr. Franzén (2 April 2003).

universities ought not necessarily follow the industrial orientation that is setting the trend.

4.2 *Vägverket*, The Road Authority

Vägverket, the Swedish road authority, has its seat in Borlänge and employs 6,500 people across 350 locations.[33] It is responsible for passenger and freight transport by road and water. Besides subjects such as safety, the environment, accessibility, and efficiency, "Vision 0" enjoys high priority in the definition of Vägverket's research programs. With a budget of €21.5 million in 2004, a ten-year (2004–2013) master program for knowledge and innovation in the road transport system stakes out five areas for development. They are (a) people in harmony with the transport system, (b) sustainability of the transport system, (c) a city for all, (d) safer and better environmental features of vehicles, and (e) increased efficiency of transport management and information for road users.

The first of these areas, "people in harmony with the transport system," had a budget of €2.3 million in 2004. The research interest centers on the venturesome nature of various road users and their different ways of using the transport system. The aim is to deepen what is understood about these groups by observing the interaction between people, vehicles, the context of transport, and technical systems. Using a sociopsychological approach, researchers are studying the factors that control the relationships involved. They are also inquiring into the effects of new technologies whose introduction can eventually make it more difficult for some groups to use the roads than is currently the case. Projects on safety serve to expand knowledge about the effect of automotive technologies such as automatic speed adaptation. This area of research includes the study of the willingness to use environmentally sound means of travel.

The topic of "sustainability of the transport system" has a current annual budget of €1 million. The program investigates the interplay of planning and construction. The researchers are looking specifically at (a) measures that can influence the transport requirements and the selection of the means of transport; (b) measures that improve efficiency in the use of the existing road network or vehicles; (c) the limited modernization of the existing structure, including the determination of the central measures for such work; and (d) new investment in the roads. Mobility management is to broaden the range of choices offered by multimodal transport. The key questions are how the transport system can become more adept at handling potential risks and how it can be more flexible and more reliable than it is at present.

The overriding objective of Vägverket's third research area, "a city for all," is to increase the number of trips taken with public transport. The capacity, quality, and competitiveness of public transport, its operation, and its maintenance are to be op-

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[33] Vägverket (Swedish Road Authority) (2001), *Annual Report, 2001* [brochure], Borlänge, Sweden.

timized for this purpose. New logistical solutions for supply and delivery transport are to be planned and tested. Work on infrastructures in cities often incurs high costs because of expensive and complex construction. The measures and costs are analyzed for their effectiveness, impacts, objectives, and acceptance. This area of research on public transportation is complemented by efforts to work out alternative models for operating and financing investments in the system as a whole, which the researchers are appraising chiefly in terms of costs and effectiveness. The 2004 budget for this area of development is €800,000.

A research program running from 2004 through 2013 deals with the safety and advancement of the environmental features of vehicles. A budget of €1.3 million has been made available for this work in 2004. It centers on the technical development of vehicles. Attention is directed to the vehicle safety requirements needed in the interest of all road users and to emission abatement by means of renewable energies such as biofuels. Research also concentrates on the function and dependability of technical equipment for maintaining active and passive safety and on the effect that the design of the driver's seat has on safe driving. The limits of human interaction with vehicles are being explored. Existing adverse environmental impacts have prompted continuation of work on the familiar topic of trying to understand what leads people to the particular means of transport they choose. Vehicle selection, components, accessories, and driving styles are the subjects of most interest.

Congestion, the effects of transporting heavy loads, and the transport of hazardous materials are the main interests of a research program on upgrading the efficiency of traffic management and information for road users. With a budget of €1.9 million in 2004, the aim of this program is to model tools and methods for assessing the effects of planned measures for managing traffic. Measures and methods of monitoring traffic and of providing information, services, and accessories while en route are being developed for this purpose. The effects of new information accessories and the long- and short-term costs entailed are being assessed.

Through the PFF initiative described above, both the government and the automotive industry are investing far more money in the following programs for vehicle development than in those described above.

"Vehicle emissions" is a subprogram headed by the PFF board. The program runs from 2003 through 2008. Of the €14 million to €22 million budgeted for it, one third comes from Vägverket, one third from other government sources, and one third from industry. The long-term objective of this sector-wide research program is to develop vehicles and components that curb automotive emissions. A short-term goal in the first three years is to strengthen the national research setting by offering opportunities for representatives of different interests and disciplines to meet and address the future need for knowledge and skills in industry and society. The collaboration of research institutes, the public sector, and industry is being intensified.

Objectives for the next five to ten years are to achieve a quantifiable curtailment of emissions from road traffic, to augment knowledge in that area, and to train scienti-

fic personnel. The program will emphasize (a) the search for functional solutions in the future development of admissible emission standards for diesel engines; (b) the keeping of emission statistics; and (c) the study of the interaction between the road surfaces and vehicles, particularly with regard to noise and particles, future alternative fuels and vehicles, and the environment and health. Attention also centers on vehicles, ITS, and traffic management.

In the same context there is a program on information technologies in vehicles: intelligent vehicle safety systems (IVSS) and smart technologies. The program runs from 2003 through 2008 and has a budget of €71 million funded by the government and industry. This research seeks ways to avoid accidents and protect against injury, to simplify and modernize the operation of vehicles, and to promote the safety of unprotected road users through use of technology and independent systems within and outside the vehicle as a way of lessening the consequences of road accidents.

This research and the attendant demonstrations center on developments in driver assistance and person-machine interfaces, a communication platform, sensor-controlled systems, ITS, the mitigation of the consequences of road accidents, biomechanics and automotive design for safety, preparedness for dealing with injuries, and reliable and dynamic safety systems in vehicles.

The developmental areas and programs described above encompass the following approved projects:[34]

- State of the art in bioalcohol admixture in gasoline
- Modeling and measurement of emissions from heavy vehicles
- Evaluation of effects that emissions from road traffic have on ecosystems
- Diesel engine with extreme emissions and fuel
- Relation between road design and noise pollution in agglomerations
- Cost analysis of the transition to nonfossil fuels
- Quantification and identification of hydrogen particles in modern diesel engines and fuels
- Emissions, impurities, noise, and impacts on health
- Direct measurement of the automotive discharge of soot and carbon dioxide
- Macroeconomic analysis of health and air quality
- ITS and the impacts on emissions
- Macroeconomic costs incurred by congestion
- Transport of trucks by rail
- Bus accidents, state of health, and weather conditions
- Summary of landscape information in the planning process
- Attitude of young people toward alcohol, transport, and information fairs

4.3 *Banverket*, The Railroad Authorities

In the course of liberalization, Statens Järnvägar (SJ), the state railroad company, was divided into six companies. One of them, the railroad authority (Banverket),[35] is

[34] www.vv.se

headquartered in Borlänge. Banverket is in charge of the infrastructure and the timetables. The train stations belong to Jernhusen. Green Cargo is responsible for freight transport. Euromaint AB (maintenance), TraffiCare AB (cleaning), and Unigrid AB (information and technology) have meanwhile been sold. Banverket's research program on the railroad system integrates four perspectives: sociocultural considerations, the market and competition, effectiveness and efficiency, and safety and the environment.

Banverket's current project list entails research on siting and development issues of the railroad system:[36]

- Train station architecture
- Innovative railroad technology
- Quality-related objectives and appropriate measurement methods
- Economic effects of environmental protection measures
- Experience with automated railroad systems
- Improvement of calculations relating to freight transport
- Study on planning processes pertaining to projects on infrastructure
- Evaluation of potentially dangerous locations
- Freight trains in the city
- Determination of the customer's willingness to pay for comfort
- Competitive pricing for the railroad
- Cost structure

Projects on the railroad's competitiveness delve into the wishes of customers, information technologies and travel behavior, decentralized logistics systems, the flow of freight and combined transport, punctuality, standardized power systems for freight trains, and the development of train cars. Technical projects are conducted on a variety of topics relating to efficiency: railroad control systems and technology, propulsion technology, and administration. The customer's role as an instrument for developing the railroad sector is also a subject of inquiry. Projects on systems safety and the environment deal with emissions and their effects on groundwater and vegetation. Other projects treat issues of safety and risk minimization.

The projects are part of the overall R&D program for 2000 through 2005, which has a government-funded budget of €7.5 to €10 million. It has subprograms, each with its own areas of development. One of them is called "rail transport systems from a societal point of view." It takes up strategic questions about the relationships between policy decisions on taxes and duties, the conditions shaping rail transport, the planning and the organization of rail transport, international cooperation, the planning and construction of railroads, coordination with other local planning ideas, and aesthetic design. The participants in this program of 36 projects include government institutions, researchers and developers, railroad operators, transport companies, the railroad industry, consultants, entrepreneurs, passengers, and customers.

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[35] Interview with Malcom Lundgren, coordinator of the research department of Banverket, 1 April 2003, Borlänge, Sweden, with Jan-Erik Gasslander representing Lars Sjöstedt.
[36] www.banverket.se

A second Banverket program supports an additional 36 research projects on the railroad system from a market perspective. To enlarge the railroad's share of the market and its attractiveness, researchers are looking into changes in the market and customer demand, the development of appealing vehicles, the appropriate design of freight vehicles for trade and industry, and logistics.

The efficiency of the railroad's internal operations is the topic of a third program under Banverket. Productivity, efficiency, the cost–function relationship, accessibility, capacity, and reliability are seen as essential to the future competitiveness of the railroad sector. Five areas of R&D are defined: efficient traffic control, railroad technology, energy supply, management, and the client's role as an instrument for developing the railroad sector.

4.4 *Energimyndigheten*—The National Energy Agency

The Swedish National Energy Agency, STEM, was founded in 1998 as a public authority. Its task is to transform the energy system into an economically and ecologically sustainable system by controlling government capital in the energy area.[37] To this end, the agency is expected to work with trade and industry, utility companies, local government, and the research community. STEM furthers the production of renewable energies, new production technologies, and the effective use of energy. Its duties include passing knowledge and information to consumers, industry, and the public sector. The agency performs regulatory tasks in the energy area and monitors the gas market.

Automotive Power Systems

The energy agency conducts a program on energy and transport centers. This ten-year program focuses on basic research on internal combustion engines and has a budget of €60 million, which is raised jointly with industry. The work is carried out at three competence centers. The topics are the combustion process, catalysis, and the technology of internal combustion engines.

A second program (1998–2004) has probed the production of ethanol from wood and has had a budget of €25 million, half of which comes from the government. The objective is to manufacture and use ethanol as an alternative and CO_2-neutral fuel. An experimental facility for bulk production of ethanol from wood has been built for this purpose. Half of the program's budget has been invested in it; the other half, in research.

A three-year program (2003–2006) with a budget of €6 million from the government is intended to foster the long-term development, distribution, and consumption of alternative fuels—ethanol, methanol, biogas, and rapeseed methylester (RME). In ad-

[37] www.stem.se

dition to exploring the production of alternative fuels, the research also addresses their introduction into the market.

The energy system of road vehicles is the topic of a program running from 2000 to 2006. Its budget of €25 million comes from the government. The objective is to work with international actors to develop new technologies that reduce the fuel consumption of new passenger cars by 50 percent and that of trucks by 20 percent. Traditional internal combustion engines, electric and hybrid vehicles, and fuel cells are being researched for this purpose. The program is part of the PFF initiative described above.

4.5 Selected Older Technical Research Projects on Transport

This section presents some of the older or completed technical research projects that are highly regarded in Swedish transport research.

ISA—Intelligent Speed Adaptation

The project on intelligent speed adaptation (ISA) has a budget of €8 million. It entails ambitious technical work on limiting speed and enhancing road safety by means of information technology instead of bollards. Systems have been tested extensively in the cities of Borlänge, Lingköping, Umeå, and Lund.[38] The test vehicles are equipped with on-board computers that record each vehicle's location within the test grounds via GPS. The on-board computers contain a digital map of the test zone and show the speed limit for each road traveled. Exceeding the speed limit triggers an acoustical alarm, which does not shut off until the speed limit is observed again. A gas pedal that blocks at excessive speed has been tested but rejected.

In the course of these tests, the number of serious accidents in the test zone fell by 25 percent and the general speed dropped. Professional taxi drivers participated in the test only briefly before removing the system. They felt restricted by it. In Gothenburg the system is meanwhile being pilot tested in buses as well. Because the idea of disseminating ISA through automotive manufacturers failed, an effort is now underway to spread the use of the system in vehicles through public administrations.

CDU—Cooperation on Maintaining the Infrastructure

The Center for the Operation and Maintenance of the Infrastructure (CDU)[39] was founded as a project in 1995 by the Royal Institute of Technology, Stockholm; the State Institute of Road and Transport Research (VTI); and Dalarna University. The goal is

[38] Interview with Birgitta Nylander and Ulla Ericson at Vägverket, Borlänge, Sweden, 1 April 2003, with Jan-Erik Gasslander representing Lars Sjöstedt and Håkan Bergeå, project manager, Borlänge.
[39] CDU brochure, April 2000, Royal Institute of Technology, Stockholm.

to promote research on and Ph.D. training for the operation and maintenance of the rail and road infrastructure. The research topics are identified and pursued by Ph.D. students, among others, in agreement with all partners. Seminars and workshops accompany this work. In 2000 the CDU had a budget of €1.6 million from the KFB (Vinnova's immediate predecessor), Banverket, Vägverket, and other organizations. In the first five years of its existence, the CDU conducted 145 projects and graduated 28 students. Cooperation is strengthened by a temporary professorship funded by one of the CDU's partners.

Program for Vehicles with Electric and Hybrid Propulsion, 1993–2000[40]

This research, development, and demonstration program for vehicles run on electric or hybrid power had a budget of €13 million and was led and funded by Vinnova's precursor, the KFB. Vehicles powered by electricity were used particularly in three conurbations. The KFB deployed fleets of more than 250 demonstration vehicles in Stockholm, Gothenburg, and Skåne, including several hundred electric and hybrid vehicles (cars, vans, buses, and trucks) in the public and private sector. The recharging, sales, and service infrastructure was built up. The vehicles, infrastructure, and experiences of the users were evaluated. Most of the results are stored in a national databank at Lund University, Department of Technology and Society.

The study involved three additional ones. The first tackled the question about the future global development of electric and hybrid vehicles and centers on markets and technologies. The second investigation delved into the socioeconomic costs and benefits of introducing electric and hybrid vehicles on a large scale. The third was on program analysis with an eye to generating proposals for action that could be taken by political decision-makers.

Because the program has been completed, the outcomes of the research and the field test are available: (a) A vast amount of technical data and the experiences of the users were analyzed. (b) It is assumed that nearly all major car manufacturers want to develop and build electric and hybrid vehicles, so this technology is thought to have an important pioneering role within the transport system. (c) Battery-powered electric vehicles could be replaced by advanced hybrid fuel-cell vehicles. (d) To facilitate the introduction of electric automotive technologies, researchers must first clarify infrastructural standards and safety questions.

Except for a few market niches, the market for electric and hybrid vehicles is still in its infancy. Half of the six hundred vehicles of these types operating in Sweden are used by public administrations and utility companies, with private companies of all sizes accounting for the rest. The prices of electric and hybrid vehicles plummeted during the program, but in most cases they remained higher than their gasoline-powered counterparts. The public sector plays a definite role in the development of electric propulsion technologies partly because the currently underdeveloped supply and

[40] Kommunikationsforskningsberedningen (KFB) Report (2000), p. 27 (see www.kfb.se).

service infrastructure for electric vehicles makes it easier to manage them in fleets. It would be possible to use battery-powered electric vehicles as city cars and small vans.

Other intriguing results showed that the energy consumption of the vehicles varied dramatically, usually because of differences in driving styles. The participants had to practice how to handle electric and hybrid vehicles. The drivers were open to using them for work but had reservations about driving them privately, feeling that they were not "proper" cars.

4.6 Progress Report

The Swedish government commits massive sums to the R&D of technologies relating to road vehicles. To defend the strong international position of the country's national transport sector and the automobile companies in the competition for markets and customers, it supports engine development, emission research, alternative power systems and fuels, information technologies within vehicles and the general transport setting, and the safety aspects of person-machine-road interfaces.

These areas enjoy far greater investment than do the railroads and public transport. But even in these two latter fields, research gravitates toward technological and logistical innovation and the issues of competitiveness and safety. Another area of concentration is the maintenance and repair of the technical infrastructure as the basis for ensuring the viability and modernization of the entire transport system.

5. Transport Research at Universities and Other Institutions of Higher Learning

5.1 Technical Research

Most of the research in Sweden is conducted at the country's 14 universities, comprising 300,000 students and 40 university institutes. Government research funds are granted to the universities and institutes either directly or indirectly by research advisory boards. Important institutions for transport research are the Royal Institute of Technology, Stockholm; Gothenburg University, Department of Business Administration; Chalmers University of Technology, Gothenburg, and Chalmers Technology Park; Lund University, Department of Technology and Society; and private and state institutes specialized in this area of inquiry. In addition to the universities, there are private offices working on transport research. They employ the university graduates and submit project applications to the research-funding institutions.

Training in transport research at Swedish universities is of a very practical nature. The students in Sweden complete their four- to five-year course of study with a Ph.D.[41] The degree requires, among other things, that these doctoral candidates work on commissioned projects, usually as employees of the university. They thereby gain a sound sense of later occupational practice and learn to work in a problem-centered, realistic manner. They spend 40 percent of their time on academics and 60 percent on research and subsequently enter a ready labor market.

Some Ph.D. projects, such as those at the Royal Institute of Technology, Stockholm, are conducted at the request of public authorities. This arrangement affords information for the project while also opening doors. The students can use their knowledge in seminars. About 10 percent of the graduates remain at the university. Most of the doctoral candidates later work for consulting firms.

For lack of funds, no Ph.D. projects in transport and siting analysis are underway at the Royal Institute of Technology, Stockholm.[42] This hiatus stems from the aforementioned changes in the conditions governing basic research.

Royal Institute of Technology, Stockholm

The Royal Institute of Technology, Stockholm, has interdisciplinary teams bringing together the disciplines of engineering, geography, architecture, and sociology for research on transport, infrastructure, and planning. The expansive department of infrastructure is divided into three main groups: city planning, transport, and logistics; systems analysis; and economics.[43] The work addresses the academic research community, Vägverket, and Banverket. One area of accentuation is the development of analytical tools and models for the future of transport. Topics include the regulation of landscape consumption for meeting transport demand; cost–benefit analyses of

[41] Interview with Professor Lars Göran Mattsson, 31 March 2003, Stockholm.
[42] Interview with Professor Lars Göran Mattsson, 31 March 2004, Stockholm.
[43] See also www.infra.kth.se

investments, fees, and prices in the public transport sector and on the road; recognition of critical interfaces in local public transport; and the use of geographic information systems, design of routes and roads, and ITS.

The availability of scientific tools facilitates the analysis and improvement of measures for creating a sound framework within which to work with facts "instead of wishful thinking." The Royal Institute of Technology, Stockholm, communicates with reference groups so that project development includes input from researchers and users of research—many of whom are employees of Stockholm planning offices and public authorities.

Gothenburg University, Department of Business Administration

At Gothenburg University, Department of Business Administration, transport management and freight transport are the focus of problem-centered research, including Ph.D. dissertations, on combined road and rail freight transport and its costs, the development of small load units for road haulage, combined passenger and freight transport, systems design, market potential, the environment, and the development and analysis of tools for assessing quality and cost.[44]

Combined road and rail transport and its marketing are a key field of interest at this institution. Another area of attention is the development of efficient and environmentally friendly distribution scenarios for the transport of goods after purchase over the Internet. Studies also probe ways for cities to attract companies and the potential that towns have for jointly operating interregional logistics centers. Further research topics are the postderegulatory change in the railroad's cost structures, competition in freight transport, and transport chains.

Chalmers University of Technology, Gothenburg, and Chalmers Technology Park

Research in the Crash Safety Division at Chalmers University of Technology, Gothenburg[45] is primarily on safety within the automobile in the event of an accident. Mechanical, mathematical, biological, and medical approaches are used to study the effects that high impacts have on humans. An important area is the examination of restraint systems in cooperation with behavioral researchers and medical specialists. Neck and brain injuries are of particular importance.

The institute also conducts basic research to broaden medical understanding of the biomechanics of children, a mostly unexplored topic. Little is known about "when they break." For example, research has revealed that car seats for children 9 months and older are often positioned incorrectly. It is argued that these passengers as well as bigger children should sit with their backs to the direction in which the vehicle is

[44] Interview with Professor Arne Jensen, Gothenburg University, School of Economics and Commercial Law, Department of Business Administration, 2 April 2003, Gothenburg.
[45] Interview with Professor Per Lövsund, Chalmers University of Technology, Gothenburg, Department of Machine and Vehicle Systems, Crash Safety Division, 2 April 2003, Gothenburg.

traveling. The fact that children today are larger than children were twenty years ago is reported to have implications for the kinds of seats used. The seated position of adults, too, poses a serious risk in the event of an accident. Research in the Crash Safety Division therefore looks into ways of bringing passengers to adopt proper posture when sitting.

The side-mounted air bag was developed at Chalmers University of Technology, Gothenburg, in cooperation with Autoliv (a worldwide American-Swedish company for automotive safety technology). The basis for the active headrest, which moves in the event of an accident, was developed with Volvo and Autoliv.

Older persons and children are the central research fields of the future. Demographic studies show that more and more older persons drive. Because current airbags injure older persons more than younger ones, there is a need for restraint systems that are more intelligent than present ones. Older persons have a higher number of accidents with cars coming from the left than from other directions. Systems for indicating these risks are being developed.

Researchers in the Crash Safety Division have noted that many interior systems function very well with test drivers but that the modern systems and driving behavior fit poorly with ordinary drivers.

Intelligent transport is the subject of investigation at the Chalmers Technology Park,[46] where traffic information services, reliable information, and the clarification of funding are regarded as topics of the future.

Lund University, Department of Technology and Society

Technology, behavior, and safety have been areas of research at Lund University, Department of Technology and Society,[47] for twenty-five years. Half of the research is funded by the university; half by Vägverket.

The Department of Technology and Society works in interdisciplinary teams consisting of engineers, psychologists, sociologists, and economists. Causal research, partly on accidents, is a sweeping field of work. In applied research on users, interviews and experiments are tools in the study of how to design public transport and the environment with older persons, people with disabilities, and children in mind. The value of an accident victim's life is calculated. All material costs arising from the loss of a human life, and even the loss of time caused by traffic jams, is expressed in monetary terms.

The research results at Lund University, Department of Technology and Society, find practical use in the local public transport system. In Lund, kneeling buses are used,

[46] Interview with Dr. Stig Franzén, Chalmers Technology Park, 2 April 2003, Gothenburg.
[47] Interview with András Várhelyi, Lund University, Department of Technology and Society, Traffic Engineering, 4 April 2003, Lund.

and approximately ninety traffic circles are under construction. Coping with bicyclists in traffic circles is still an unsolved problem. Dynamic speed limits on major roads are another current topic in Sweden.

The Division of Packaging Logistics in the Department of Design Sciences at Lund University[48] is conducting an interdisciplinary inquiry into product design, packaging, packaging processes, and the development and control of the raw-materials distribution system across all phases of production down to the consumer and recycling. The objective is to ensure safe, low-cost transport that conserves resources. Logistics account for up to one third of a product's total costs, and packaging can make up as much as two thirds of the costs for logistics. The lack of experts with research or practical experience is seen as one of the chief reasons for the relatively high logistics costs in Sweden. Study at Lund University, Department of Technology and Society, aims to offset this shortcoming and stresses technology as well as design.

The Institute of Roads and Transport Research

The Institute of Roads and Transport Research is one of the few state research centers. It is seated in Linköping and reports to the Ministry of Industry, Employment, and Communication. The institute's task is to conduct applied research on topics relating to the infrastructure, traffic, and transport. Vägverket, the Swedish road authority, is the principal client. Research is commissioned by Vinnova, SIKA, Banverket, and other authorities. The institute is experienced in research on traffic engineering, transport economy, transport demand, environmental impacts of traffic, road-user behavior, accident safety, planning, design, construction, and the operation and maintenance of roads and rails. In September 2004 the Institute of Roads and Transport Research published the results of its research on people's use of mobile telephones with headphones while driving. It determined that the risk of having an accident always increases about fourfold when a person telephones while driving, even if headphones are employed.[49]

5.2 Social Science Transport Research[50]

The topics of private passenger transport are treated in basic and applied social science research[51] from a psychological and sociological perspective. Particular attention is devoted to promoting traffic safety and mitigating the transport system's impacts on the environment. The research at the universities is funded by Vinnova and Vägverket.

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[48] Interview with Professor Gunilla Jönson, Lund University, Department of Design Sciences, Division of Packing Logistics, 3 April 2003, Lund.
[49] Press release by the Institute of Roads and Transport Research, 9 September 2004. See www.vti.se.
[50] All information stems from the report by Dr. Maria Johansson, Department of Environmental Psychology, Lund University, Department of Technology and Society, 7 July 2003.
[51] For documentation, see the interim country report on Sweden by Anke Borcherding, Wissenschaftszentrum Berlin für Sozialforschung, 18 September 2003.

Gaining access to details and results of the projects is difficult, partly because documentation is usually unavailable. The projects cover an extensive range of social science transport research. The most important topic areas are driving behavior and the public attitude toward traffic safety, driver's training for young people, risk abatement for pedestrians and bicyclists, traffic safety for children, the mobility of older persons and people with disabilities, public transport, design, information technologies, an understanding of what leads people to the particular means of transport they choose, and moderation of car use.

Driving Behavior and the Public Attitude toward Traffic Safety

Considered essential to traffic safety, driving behavior is studied in order to acquire basic knowledge about human behavior in road traffic. Neurophysiological and cognitive models are then derived to explain the reasons for accidents, to understand drivers' automatic reactions, and to gain insight into the human perception of external visual information. Researchers examine drivers' attitudes toward traffic violations and driving mistakes in order to draw conclusions about the personality of drivers, informal rules between drivers, and the effects of these factors. Careless and sleepy drivers pose high risk. The question is what information or measures are required in order to make drivers aware of these risks and, if necessary, to keep those people from driving. Zones with high risk of accidents are a subject of this research, as are groups exhibiting risky behavior, such as the disinclination of truck drivers to use safety belts. There have been attempts to raise the awareness of traffic safety among immigrants and to include them in the work on traffic safety. Local projects try to affect the attitude of residents.

Driver-training for Young People

Young drivers have a disproportionately high incidence of traffic accidents. To bring down the number of those accidents, research in this area evaluates social factors such as life styles, group processes, and personality and hones the didactic strategies of driving schools.

Risk Reduction for Pedestrians and Bicyclists

To help diminish the number of accidents involving pedestrians and bicyclists, researchers analyze the circumstances surrounding accidents. This field of work also investigates the spread of bicycle helmets within different population groups and age cohorts and explores the factors that can encourage bicyclists to wear helmets.

Traffic Safety for Children

Projects on traffic safety for small children primarily mainly endeavor to impart knowledge about the proper use of available safety equipment. A research center on the topic of children and road traffic focuses on cognitive development, alertness, and the comprehension of traffic regulations among school-age children.

In the 1990s social science transport researchers began to take interest in the perspective of children and found that the environment had to be adapted to the abilities of children, not vice versa. They also learned that children should play an active role in planning local traffic conditions. Building on these insights, Vägverket developed a method to include children in that process. A local study is pursuing these ideas further.

The safety of school buses and children at and en route to or from bus stops receives the most attention. Accidents in which children are injured or killed are analyzed. This work has resulted in a manual for bus drivers and appropriate designs of bus stops and information displays.

Parents seldom allow their children to walk or bicycle alone. Researchers are studying what effect this attitude has on children.

The Mobility of Older Persons and People with Disabilities

A center for research on the transport environment for older persons and people with disabilities has been created at Lund University. The approach there is broad and encompasses work on safety, the quality of life, needs, and mobility. The researchers are studying the question of how public transport can be adapted to address the needs of the older population and how information technology can be used. Much of the work on the mobility of older persons deals with women. Another project is studying the ways in which the social activity and the social network of older persons are affected when they can no longer drive by themselves. The risk of having an accident escalates among older people because of their waning physical and cognitive abilities. Ways of objectively and subjectively ascertaining their driving abilities are being studied.

There are links between research on older road users and that on road users with disabilities. Both groups are the subjects of mobility projects on the accessibility of public transport and of entire routes. The supporting role of information technologies for these groups is under study. To enhance the mobility of persons with mildly limited cognitive abilities, the presentation of information needs to be less abstract and complex than they are at present. The same is true of the learning material used in the theoretical part of driver's training.

Public Transport, Design, and Information Technologies

Research is being conducted on the perception that different user groups have of the time a journey takes, of changes in travel conditions, and of comfort. One study identifies the difference between objective conditions and the subjective satisfaction of the users. Over the years it has become clear that some groups experience the use of public transport as less safe than the use of a car and that potential customers are being scared off. Research is aimed at identifying which groups are underrepresented because of their fears and at how vehicular and contextual improvements can lead to a greater sense of safety.

Ways of enlisting different population groups in redesigning the transport environment are being studied, as is attendant experience with new designs. Some inquiries show that design can help reduce speed and ease conflict situations. Other projects attempt to development theories and models in this field of research. The application and adoption of information technologies in cars and public transportation by different user groups is being looked at from a social science perspective.

Understanding What Leads People to Choose Particular Means of Transport and Reducing the Use of Cars

This work delves into the psychological and social motives, values, and life styles that influence people when they choose a means of transport. Researchers try to find out what the view of an automobile consists of and how that view relates to the perception of the natural environment. There are signs that fewer young urbanites are acquiring a driver's license, and that they are doing so later, than the members of earlier generations. One field of research takes up the question of why the members of this population group choose the means of transport they do and asks about the degree to which the lives and attitudes of teenagers are influenced by the unavailability of a car in the household. Most of the local projects for cutting back on the use of private cars rely on voluntary changes in behavior by raising awareness of health and the environment and investing in alternative ways of travel. Studies are also being conducted on the actual effect of transport demand management, carsharing, environmentally sound driving habits, and the use of electric cars.

6. Examples of Local Activities: The City of Gothenburg[52]

Several municipalities are conducting large projects that could be highly interesting to German transport research. The goal is often to curtail the use of automobiles. Most of the projects rely on voluntary changes in behavior by fostering an awareness of health and the environment and by investing in alternative forms of travel. Topics long discussed in Germany have been acted on by Swedish municipalities at immense expense and with intense commitment, including evaluation research. Carsharing, multimodal travel alternatives, ITS, low-pollution cars, and smart cards are being tested in Lundby, a district of Gothenburg, by means of a scientific field experiment on bettering the traffic conditions in an area of urban development. In practice, the topics of traffic, urban planning, and economic development are treated in the context of sustainability and mobility. This project grew out of pilot activities involving the introduction of an environmental zone in downtown Gothenburg and the extensive use of low-pollution cars by public authorities, private business, and private households. A vast program on user-friendly information systems and services (GOTIC)[53] was set up by Vinnova's precursor (the KFB) and Chalmers University of Technology, Gothenburg, in 1994.

Trafikkonteret, The Traffic and Public Transport Authority

The small traffic authority, *Trafikkontoret*, is responsible in Gothenburg for traffic. It was a traditional highway construction bureau until 1994, when it conceived its first environmental program and set criteria for an environmentally sound transport system. Volvo worked on cars and buses powered by biogas or other natural fuels for this project. The city planned to buy new busses and worked with the local suppliers for this purpose. Small businesses were called on to develop filters for diesel buses in return for a promise that the city would test them. This arrangement stimulated progress on new types of vehicles.

Evaluation of the environmental zone established in 1996, which has meanwhile been expanded, has shown that most inhabitants of Gothenburg like it. The major companies are especially in favor of it, for they have adapted their fleets of vehicles and therefore enjoy a competitive advantage. The zone's introduction prevailed over strong local resistance.

In 1998 a communication and information campaign was launched to promote environmentally friendly automobiles. At first, there were no criteria for defining such vehicles. Vägverket later adopted Gothenburg's criteria, which were initially based on the guidelines set forth by a 1996 parliamentary commission on alternative fuels. It stipulated that automobiles and light vehicles (less than 3.5 tons) are environmentally friendly if they are powered by fuels other than gasoline or diesel for more than

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[52] Interviews with Lisa Sundell, project manager with the city of Gothenburg, *Trafikkontoret* [Traffic and Public Transport Authority], 2 April 2003 and 1 April 2004, Gothenburg.
[53] www.trafikkontoret.goteborg.se/gotic

50 percent of the time they are in operation. Commercially available alternatives were electricity, ethanol E85, rapeseed methylester (RME), natural gas, biogas, and propane. In 2000 a new definition was adopted because new models of environmentally friendly automobiles had come onto the market. Even vehicles heavier than 3.5 tons were included.

Gothenburg currently defines environmentally friendly vehicles as—

- light vehicles powered by electricity, gas, ethanol, or rape oil for more than 50 percent of their operating time, and hybrid, fuel cell, and low-consumption vehicles, such as automobiles that burn less than 3.8 liters of gasoline (about 62 miles per gallon) or 3.4 liters of diesel (about 69 miles per gallon). Diesel vehicles must meet the standards of environmental class 1.

- heavy vehicles powered by electricity, gas, ethanol, or rape oil for more than 50 percent of their operating time, and hybrid and fuel cell vehicles that comply with the EU's environmental standards.

An large demonstration fleet has been created in Gothenburg, and company employees have been invited to test drive these low-pollution cars for one week. Incentives include free downtown parking or, for taxis, a special parking lane. A free cost–benefit analysis of using these vehicles is also offered. Two thousand low-pollution cars are presently being driven in Gothenburg. Such vehicles already account for half the fleet of public vehicles, and the goal is 80 percent. Public authorities not using these environmentally friendly vehicles are fined.

Continuing to encourage behavioral change through enlightenment, authorities in Gothenburg have begun a dialogue with the public to keep the subject of transport on the agenda. They are turning to new tools, such as a mobility-management program, ITS, and user information.

Vision Lundby

Vision Lundby is a long-term joint project to develop sustainable alternatives for passenger and freight movement that both reduce transport-related environmental impacts and meet acceptable standards of accessibility and safety. As part of Gothenburg's inner city, Lundby suffers from the decline of traditional industries. With its mix of residential areas, schools, and businesses, it faces strong pressure to modernize. The island of Lundby is dominated by water (a port and former shipyard, a river, and flat landscape). "Smart transport alternatives" are being developed, tested, and implemented for this area of town and its many different subsidiary centers, which have attracted enterprises of every size, from multinationals to small businesses. In 2000 Lundby had 32,000 inhabitants and 21,000 jobs. The number of residents is expected to double upon completion of housing in the area of the former port and shipyard. This development will have specific transport-related consequences (bridges, tunnels, and ferries). The municipality does much to organize mobility for its

current and anticipated population and to put freight transport (containers) on a sustainable footing.

As a service hub, the Mobility Center in Lundby offers the local organizations and residents efficient and sustainable solutions for the transport of passengers and goods. It focuses on “smart” communication for businesses; cooperation on freight transport; carsharing; and “smart” communication for individuals and groups such as bicyclists, children, and adolescents.

From 2000 to 2001, Professor Roland Scholz of the Eidgenössische Technische Hochschule in Zürich—visiting professor of environmental science at both Chalmers University of Technology, Gothenburg, and Gothenburg University—conducted a case study commissioned by Volvo; Chalmers University of Technology, Gothenburg; Gothenburg University; and the city of Gothenburg.

7. Conclusion

Swedish transport research is relatively well organized; attached to clear, ambitious political targets; market oriented, practical, and pragmatic. It is also well funded and well staffed.

The objectives of this research are defined by the policy-making community and by society. The research deals primarily with mass motorization's familiar impacts on the natural and urban environment and on human beings. As approaches to these problems, however, setting environmental standards, safety standards, and speed limits and heeding the needs of relatively vulnerable road users (children, older persons, people with disabilities, pedestrians, and bicyclists) are guided by reason more in Sweden than in Germany. With its leaner political and administrative structure, Sweden seems to have an easier time controlling transport research than Germany does.

This review of social science transport research in Sweden has brought to light a host of projects, of which some ought to be of interest in the German context. Basic and applied social science research on transport have two main objectives: to improve traffic safety, especially for vulnerable road users, and to mitigate the environmental impacts of the current transport system by studying the factors that lead people to choose and use a particular a means of transport.

Several Swedish municipalities are conducting major projects that may be of considerable interest for German transport research. Frequently, the objective is to curtail the use of automobiles. Most of the local projects for cutting back on the use of private cars rely on voluntary changes in behavior by raising awareness of health and the environment and investing in alternative ways of travel. Moreover, topics under discussion in Germany have been acted on by Swedish municipalities at immense expense and with great commitment. Carsharing, multimodal travel alternatives, ITS, low-pollution cars, and smart cards are being tested in the field. Environmental zoning in some inner-city areas and the planned introduction of a duty on dust emissions in downtown Stockholm (a system modeled on practice in London) are scientifically grounded political decisions that serve informed efforts to help the environment.

The Ph.D. training at Swedish universities and other institutions of higher education deserves special recognition. The degree requires, among other things, that the doctoral candidates work on commissioned projects, usually as employees of the university. They thereby gain a sound sense of later occupational practice and learn to work in a problem-centered, realistic manner.

Swedish transport research addresses the same topics for both road and rail traffic. Because Sweden has its own automotive industry, far-ranging and expensive research programs heavily subsidized by the Swedish government are conducted in this area. To ensure the competitiveness of the country's automotive industry, efforts

concentrate on subjects pertaining to the environment (innovative power systems and fuels, hybrids, and fuel-cell vehicles) and safety (technical innovations in and outside the vehicle). Funding for research on public transport by road and rail is far more modest. In that field, too, however, technological and logistic innovation, competitiveness, safety, and the infrastructure are priorities. Funding of motorized transport of individuals has priority in Sweden, too.

Transport research in Sweden is not fundamentally different from that in Germany. The stated objectives do differ in rank, however. The foremost, but as yet unachieved, goal in Germany—integrated transport—is not an explicit item on the agenda in Sweden. Accordingly, little Swedish research on this subject surfaced. Projects that one could regard as wholly new or especially innovative in relation to the German context were not discovered.

The structures of transport research in Sweden are undergoing periodic change. That fact alone makes it difficult to identify transferable structures. In addition, however, Sweden and Germany are fundamentally dissimilar in size, geography, and sociopolitical culture. What the two countries have in common are a strong and influential automotive industry and the usual transport problems. In Sweden, answers to them are sought and offered within social science research and at the local level. The other research on passenger and freight transport seeks high-tech, mechanical, and logistical ways to make passenger and freight transport safe, smooth, and sustainable. No especially striking projects were found or reported in that area, either.

The current change in Swedish transport research is expected to optimize its market orientation. Achieving that goal is entailing at least some problems and is, of course, fomenting resistance by basic researchers who believe they are being left out in the cold. But others are adopting a wait-and-see attitude, applying for project funding, and continuing their research. This change of direction and organization is not the first and will not be the last.[54]

The new line of research funding in Sweden enhances cooperation between universities, business, public institutions, research institutes, and academic disciplines. If this cooperation can be increased to advance economically, socially, and politically defined objectives of sustainability, and if those objectives can be linked even more closely with the promotion of economic development than is already the case, then Sweden could in fact become a European model to emulate.

[54] Interview with Professor Tommy Gärling, Department of Psychology, Gothenburg University, 2 April 2004, Gothenburg.

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www.vti.se

www.vv.se

Appendix 3: Contact Information Relating to Transport and Transport Research

Banverket (Swedish Rail Administration) Responsible for the state railroads in Sweden

Energimyndigheten

Formas Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning

TFK (Transport Research Institute) Freight transport and logistics, materials handling and transportation engineering, public transportation, traffic systems

KFB (Swedish Transport and Communications Research Board) KFB is now a part of Vinnova

LFV (Swedish Civil Aviation Administration) Responsible for all of Sweden's airports and all air traffic

MISTRA (Foundation for Strategic Environmental Research) supporting strategic environmental research. MISTRA ist für Nachhaltigkeitsforschung zuständig, hat ein hohes Budget, aber nach eigener Aussage keine Verkehrsexperten

Naturvårdsverket (Swedish Environmental Protection Agency) Environmental protection, focusing on transport, the agricultural and forestry sectors (biological diversity), trade and industry (industrial production, goods, waste)

Rikstrafiken Administrative body with the aim to develop a co-ordinated long-distance public transport system

SIKA (Swedish Institute for Transport and Communications Analysis) Analysing and presenting data, prognoses and statistics within the communication sector

SJ AB (The Swedish State Railways) SJ is owned by the Swedish state and runs the main part of the Swedish railroadsystem

VTI (Swedish Road and Transport Research Institute) Transport; policy, economics, supply and demand, traffic engineering, road safety, road user behaviour/human factors, vehicle engineering, collision safety, highway/railway engineering/maintenance and operation of roads and railways

Vinnova Agency for Innovation Systems, National government agency

Vägverket (Swedish National Road Administration) is responsible for the development and maintenance of the road transport system in Sweden

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